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- (71) Applicant (for GB only): **PFIZER LIMITED** [GB/GB];  
Ramsgate Road, Sandwich, Kent CT13 9NJ (GB).
- (71) Applicant (for all designated States except GB, US):  
**PFIZER INC.** [US/US]; 235 East 42nd Street, New York,  
NY 10017 (US).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): **JENKINSON, Stephen** [GB/GB]; Pfizer Global Research and Development, Ramsgate Road, Sandwich, Kent CT13 9NJ (GB). **O'REILLY, Mark, Anthony** [GB/GB]; Pfizer Global Research and Development, Ramsgate Road, Sandwich, Kent CT13 9NJ (GB). **TREVETHICK, Michael, Andrew** [GB/GB]; Pfizer Global Research and Development, Ramsgate Road, Sandwich, Kent CT13 9NJ (GB).
- (74) Agents: **RUDDOCK, Keith, S. et al.**; Pfizer Limited, Ramsgate Road, Sandwich, Kent CT13 9NJ (GB).
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(54) Title: HISTAMINE RECEPTOR ANTAGONISTS

(57) Abstract:

## HISTAMINE RECEPTOR ANTAGONISTS

This invention relates to a combination of a histamine H<sub>1</sub> receptor antagonist and a selective histamine H<sub>4</sub> receptor antagonist for the treatment of a range of diseases that may be treated by antagonism of either or both of the H<sub>1</sub> and H<sub>4</sub> receptors including allergic diseases and disorders such as allergic rhinitis and asthma, to the uses of, and to compositions, products and methods of treatment including, such a combination. This invention also relates to a selective histamine H<sub>4</sub> receptor antagonist.

Allergies are widespread and affect a large proportion of the world population. They may be seasonal in nature and can be caused by a variety of factors present in the environment such as pollen, mites and dust particles.

Symptoms of allergic rhinitis, which may be seasonal or perennial, can include rhinorrhea, nasal congestion and irritation, often accompanied by coughing or sneezing. Irritation and soreness of the throat and eyes is also common. The level of severity of each symptom experienced may vary from representing a minor problem to a person experiencing a severe effect.

The use of a histamine H<sub>1</sub> receptor antagonist in the treatment of allergic rhinitis is well-documented but when administered alone it does not provide an effective relief for nasal blockage and such agents are therefore often administered concurrently with sympathomimetic amine decongestants such as phenylpropanolamine and pseudoephedrine. However, such concomitant therapy is not suitable for all patients since central nervous system and cardiovascular side effects are often observed. WO98/06394 discloses the use of a combination of a histamine H<sub>1</sub> receptor antagonist and a histamine H<sub>3</sub> receptor antagonist for the treatment of allergy-induced responses in the mammalian airway, including relief from nasal congestion.

There exists a need for additional effective treatments of allergic diseases and disorders such as allergic rhinitis and asthma. There is a particular need for an alternative therapy to provide relief from most, if not all, the symptoms of allergic rhinitis, including nasal congestion.

The present invention is based on the teaching of EP 1096009 A1 (European Patent Application no. 00309364.8) in which, *inter alia*, a polynucleotide encoding for a polypeptide corresponding to a G-protein coupled receptor (GPCR), newly termed by other researchers the histamine H<sub>4</sub> receptor, are described and claimed. Although a compound that antagonises or selectively antagonises such a polypeptide is also disclosed in general terms, there is no definition or discussion of the meaning of selectivity. Further, there is no mention that antagonists of such a polypeptide may be used in combination with a histamine H<sub>1</sub> receptor antagonist. The teaching of this document is incorporated herein by reference. In the document the histamine H<sub>4</sub> receptor is defined as a polypeptide comprising:

- (a) a polypeptide having the deduced amino acid sequence translated from the polynucleotide sequence in SEQ ID NO: 1 and variants, fragments, homologues, analogues and derivatives thereof;
- (b) a polypeptide of SEQ ID NO: 2 and variants, fragments, homologues, analogues and derivatives thereof; or
- (c) a polypeptide encoded by the cDNA of NCIMB 41073 and variants, fragments, homologues, analogues and derivatives thereof.

The definitions of the above terms relating to the polypeptide are to be understood to be in conformity with the teaching of EP 1096009 A1 (European Patent Application no. 00309364.8) and, in particular, the terms "variant", "homologue", "fragment", "analogue" or "derivative" in relation to the amino acid sequence for the polypeptide include any substitution of, variation of, modification of, replacement of, deletion of or addition of one (or more) amino acid from or to the sequence providing the resultant polypeptide has GPCR activity, preferably being at least as biologically active as the polypeptide shown in attached SEQ ID NO: 2. In particular, the term "homologue" covers homology with respect to

structure and/or function. With respect to sequence homology, there is at least 70%, preferably at least 75%, more preferably at least 80%, more preferably at least 85%, more preferably at least 90%, more preferably at least 95% homology to the sequence shown in SEQ ID NO: 2. Most preferably there is at least 98% homology to the sequence shown in SEQ ID NO: 2.

This polypeptide corresponds to the orphan G-protein-coupled receptor encoded GPRv53, that has been surmised to be a novel histamine H<sub>4</sub> receptor, as described in The Journal of Biological Chemistry, 275(47), 36781-36786 (November 2000), the teaching of which is incorporated herein by reference.

We have surprisingly found that histamine-induced chemotaxis (migration towards a chemoattractant) of human eosinophils appears to be mediated by the histamine H<sub>4</sub> receptor and not by the histamine H<sub>3</sub> receptor and therefore that histamine H<sub>4</sub> receptor antagonists prevent histamine-induced chemotaxis of human eosinophils. Eosinophils have been implicated in the pathogenesis of inflammatory and allergic diseases such as asthma and allergic rhinitis and high levels of histamine are released in patients with these conditions. Histamine H<sub>4</sub> receptor antagonists may be advantageously used in treating such conditions since (i) they are likely to inhibit eosinophil infiltration into the nose and thus relieve nasal congestion by an additional or independent mechanism to antagonism of the histamine H<sub>3</sub> receptor, or (ii) by inhibiting eosinophil infiltration into the lung they are likely to reduce the inflammation associated with asthma and provide an effective alternative treatment for this disease.

A combination of a selective histamine H<sub>4</sub> receptor antagonist and a histamine H<sub>1</sub> receptor antagonist may be advantageously used to treat allergic rhinitis since it would treat all the main symptoms of this disease including nasal congestion. A combination of a selective histamine H<sub>4</sub> receptor antagonist and a histamine H<sub>1</sub> receptor antagonist may be advantageously used to treat asthma since it may improve lung function in a synergistic manner.

The present invention provides a combination of (a) a histamine H<sub>1</sub> receptor antagonist and (b) an antagonist that is at least 10-fold selective for the histamine H<sub>4</sub> receptor as compared to the histamine H<sub>3</sub> receptor.

The present invention also provides a combination of (a) a histamine H<sub>1</sub> receptor antagonist and (b) an antagonist that is at least 10-fold selective for the histamine H<sub>4</sub> receptor as compared to the histamine H<sub>3</sub> receptor, for administration simultaneously, separately or sequentially, for use as a medicament for the treatment of a disease or disorder that may be treated by antagonism of either or both of the histamine H<sub>1</sub> and H<sub>4</sub> receptors such as allergic rhinitis or asthma.

The present invention further provides the use of a combination of (a) a histamine H<sub>1</sub> receptor antagonist and (b) an antagonist that is at least 10-fold selective for the histamine H<sub>4</sub> receptor as compared to the histamine H<sub>3</sub> receptor, for administration simultaneously, separately or sequentially, for the manufacture of a medicament for the treatment of a disease or disorder that may be treated by antagonism of either or both of the histamine H<sub>1</sub> and H<sub>4</sub> receptors such as allergic rhinitis or asthma.

The present invention further provides a method of treatment of a mammal, including a human being, to treat a disease or disorder that may be treated by antagonism of either or both of the histamine H<sub>1</sub> and H<sub>4</sub> receptors such as allergic rhinitis or asthma including simultaneous, separate or sequential administration to the mammal of a (a) an effective amount of a histamine H<sub>1</sub> receptor antagonist and (b) an effective amount of an antagonist that is at least 10-fold selective for the histamine H<sub>4</sub> receptor as compared to the histamine H<sub>3</sub> receptor.

The present invention further provides a pharmaceutical composition including (a) a histamine H<sub>1</sub> receptor antagonist and (b) an antagonist that is at least 10-fold selective for the histamine H<sub>4</sub> receptor as compared to the histamine H<sub>3</sub> receptor, and a pharmaceutically acceptable excipient, diluent or carrier.

The present invention further provides a product containing (a) a histamine H<sub>1</sub> receptor antagonist and (b) an antagonist that is at least 10-fold selective for the histamine H<sub>4</sub> receptor as compared to the histamine H<sub>3</sub> receptor as a combined preparation for simultaneous, separate or sequential use in the treatment of a disease or disorder that may be treated by antagonism of either or both of the histamine H<sub>1</sub> and H<sub>4</sub> receptors such as allergic rhinitis or asthma.

The present invention further provides an antagonist that is at least 10-fold selective for the histamine H<sub>4</sub> receptor as compared to the histamine H<sub>3</sub> receptor, the uses of and compositions and methods of treatment including, such an antagonist. Such a selective antagonist has not been previously described and thioperamide and clobenpropit, both of which are histamine H<sub>3</sub> receptor antagonists, do not display this degree of selectivity.

The definition "an antagonist that is at least 10-fold selective for the histamine H<sub>4</sub> receptor as compared to the histamine H<sub>3</sub> receptor" as used herein means an antagonist that is at least 10-fold selective for the histamine H<sub>4</sub> receptor as defined in EP 1096009 A1 (European Patent Application no. 00309364.8) or as the orphan G-protein-coupled receptor encoded GPRv53 as disclosed in The Journal of Biological Chemistry, 275(47), 36781-36786 (November 2000) as described above, as compared to the known histamine H<sub>3</sub> receptor, by the biological assays described below.

Preferably, the antagonist is at least 30-fold selective for the histamine H<sub>4</sub> receptor as compared to the histamine H<sub>3</sub> receptor.

Preferably, the antagonist is at least 50-fold selective for the histamine H<sub>4</sub> receptor as compared to the histamine H<sub>3</sub> receptor.

Preferably, the antagonist is at least 100-fold selective for the histamine H<sub>4</sub> receptor as compared to the histamine H<sub>3</sub> receptor.

Preferably, the antagonist is at least 1000-fold selective for the histamine H<sub>4</sub> receptor as compared to the histamine H<sub>3</sub> receptor.

The definition "histamine H<sub>1</sub> receptor antagonist" is well-understood in the art and is in accordance therewith.

The diseases or disorders that may be treated with the present combination or antagonist include those which may be modulated by antagonism of the H<sub>4</sub> receptor such as those which concern aspects of signal transduction. Useful therapeutic areas include, but are not limited to, obesity, diabetes and metabolic disease, neurological disease, psychotherapeutics, urogenital disease, reproduction and sexual medicine, inflammation, cancer, tissue repair, dermatology, skin pigmentation, photoageing, frailty, osteoporosis, cardiovascular disease, gastrointestinal disease, anti-infection, allergy and respiratory disease, sensory organ disorders, sleep disorders and hairloss.

Preferred diseases or disorders that may be treated are allergic disorders such as extrinsic asthma, rhinitis (allergic and chronic), onchocercal dermatitis, atopic dermatitis, drug reactions and NERDS (nodules, eosinophilia, rheumatism, dermatitis and swelling), vasculitic granulomatous diseases such as temporal vasculitis, Churg-Strauss syndrome, polyarteritis, Wegner's granulomatosis and eosinophilic granulomatous prostatitis, immunological disorders such as autoimmune reactions (e.g. multiple sclerosis), graft rejection and intrinsic asthma, interstitial and other pulmonary diseases such as chronic obstructive pulmonary disease (COPD), eosinophilic pleural effusions, transient pulmonary eosinophilic infiltrates (Löffler), histiocytosis, chronic eosinophilic pneumonia, hypersensitivity pneumonitis, allergic bronchopulmonary aspergillosis, sarcoidosis, idiopathic pulmonary fibrosis and topical eosinophilia, infectious parasitic diseases such as toxocariasis, filariasis, schistosomiasis, trichinosis, strongyloides, ascariasis and echinococcosis/cysticercosis, other infectious diseases such as acute coccidioidomycosis, cat scratch disease, afebrile tuberculosis and chlamydial pneumonia at infancy, neoplastic and myeloproliferative diseases such as bronchogenic carcinoma, hypereosinophilic syndrome, T-cell lymphomas and Hodgkin's disease, inflammatory conditions such as inflammatory bowel diseases (e.g. ulcerative colitis, Crohn's disease) and sinusitis, and coeliac disease, obstructive hepatic disease and dermatitis herpetiformis.

Particularly preferred diseases or disorders that may be treated are selected from the group consisting of asthma (both extrinsic and intrinsic), rhinitis (allergic and chronic), COPD and inflammatory bowel diseases, or that consisting of allergic disorders, vasculitic granulomatous diseases, immunological disorders, interstitial and other pulmonary diseases, infectious diseases, inflammatory diseases, and neoplastic and myeloproliferative diseases. Preferably, said allergic disorder is extrinsic asthma or rhinitis (allergic or chronic), said immunological disorder is intrinsic asthma, said pulmonary disease is COPD and said inflammatory diseases are inflammatory bowel diseases.

The selectivity of an antagonist for the histamine  $H_3$  or  $H_4$  receptor can be determined by the following procedures.

The cDNA for the human histamine  $H_3$  and  $H_4$  receptor can be expressed in a suitable cell line such as HEK293 or CHO. In addition membranes can be prepared from tissues or cells which naturally express either the histamine  $H_3$  and/or  $H_4$  receptor. Affinity can be assessed at either receptor by assessing the ability of ligands to inhibit the binding of a suitable radioactively labelled ligand to membranes containing either the histamine  $H_3$  or  $H_4$  receptor. The potency of compounds is compared by calculating their  $pK_i$  values.

The functional activity of ligands to determine agonist or antagonist activity is determined in whole cells expressing either the  $H_3$  or  $H_4$  receptor. Agonists (full or partial) are identified as agents which inhibit forskolin stimulated cyclic AMP production which can be measured directly (as cyclic AMP) or indirectly as changes in beta-lactamase activity in cells co-expressing the CRE-beta-lactamase reporter system and the appropriate histamine receptor. Agonist activities may be expressed as  $IC_{50}$  values. Inverse agonists can also be identified by the inhibition of the basal cAMP activity (i.e. in the absence of forskolin). Agents which have no effect on forskolin stimulated cAMP or inhibit basal cAMP may be antagonists and such activity can be measured in an assay where cells are pre-incubated with the ligand of interest



and their ability to inhibit  $H_3$  or  $H_4$  agonist-induced reduction of forskolin stimulated cyclic AMP is measured as described above. The experiments can be performed in one of two ways. Firstly, by increasing the concentration of antagonist *versus* fixed concentration of agonist and calculating the  $IC_{50}$  for  
5 each antagonist. Secondly, by increasing the concentration of antagonist *versus* increasing the concentration of agonist and expressing the antagonist potency as a  $pk_b$  or  $pA_2$  value, as appropriate.

A further functional assay for the histamine  $H_4$  receptor determines the ability of histamine to induce chemotaxis in eosinophils isolated from human  
10 blood. In this assay cells are primed with interleukin 5 and the ability of histaminergic ligands to promote migration of eosinophils across a permeable membrane is studied. The number of cells migrating in a defined period is then counted. Agonist potencies are expressed as  $EC_{50}$  values. Antagonists can also be studied by pre-incubating eosinophils with the compound and then  
15 assessing the inhibitory effects on histamine (or other suitable ligand) on eosinophil chemotaxis. The experiments can be performed in one of two ways. Firstly, by increasing the concentration of antagonist *versus* fixed concentration of agonist and calculating the  $IC_{50}$  for each antagonist. Secondly, by increasing the concentration of antagonist *versus* increasing the concentration of agonist  
20 and expressing the antagonist potency as a  $pk_b$  or  $pA_2$  value, as appropriate. Using this assay we have shown that histamine-induced chemotaxis of human eosinophils appears to be mediated by the histamine  $H_4$  receptor and not by the histamine  $H_3$  receptor.

The present combination (or each active element thereof) or antagonist  
25 can be administered alone but will generally be administered in admixture with a suitable pharmaceutical excipient, diluent or carrier selected with regard to the intended route of administration and standard pharmaceutical practice.

For example, the present combination or antagonist can be administered orally, buccally or sublingually in the form of tablets, capsules, multi-  
30 particulates, gels, films, ovules, elixirs, solutions or suspensions, which may contain flavouring or colouring agents, for immediate-, delayed-, modified-,

sustained-, pulsed- or controlled-release applications. The present combination or antagonist may also be administered as fast-dispersing or fast-dissolving dosage forms or in the form of a high energy dispersion or as coated particles. Suitable formulations of the present combination or antagonist may be in  
5 coated or uncoated form, as desired.

Such solid pharmaceutical compositions, for example, tablets, may contain excipients such as microcrystalline cellulose, lactose, sodium citrate, calcium carbonate, dibasic calcium phosphate, glycine and starch (preferably corn, potato or tapioca starch), disintegrants such as sodium starch glycolate,  
10 croscarmellose sodium and certain complex silicates, and granulation binders such as polyvinylpyrrolidone, hydroxypropylmethylcellulose (HPMC), hydroxypropylcellulose (HPC), sucrose, gelatin and acacia. Additionally, lubricating agents such as magnesium stearate, stearic acid, glyceryl behenate and talc may be included.

15

#### General Example

A formulation of a tablet could typically contain from 0.01mg to 500mg of each active element of the combination or of the antagonist whilst tablet fill weights may range from 50mg to 1000mg. An example of a formulation for a 10mg  
20 tablet is illustrated below:

<u>Ingredient</u>	<u>%w/w</u>
Pharmaceutically active agent(s)	10.000*
Lactose	64.125
25 Starch	21.375
Croscarmellose sodium	3.000
Magnesium Stearate	1.500

\* Quantity adjusted in accordance with drug activity.

30

The tablets are manufactured by a standard process, for example, direct compression or a wet or dry granulation process. The tablet cores may be coated with appropriate overcoats.

Solid compositions of a similar type may also be employed as fillers in  
5 gelatin or HPMC capsules. Preferred excipients in this regard include lactose, starch, a cellulose, milk sugar or high molecular weight polyethylene glycols. For aqueous suspensions and/or elixirs, the present combination or antagonist may be combined with various sweetening or flavouring agents, colouring matter or dyes, with emulsifying and/or suspending agents and with diluents  
10 such as water, ethanol, propylene glycol and glycerin, and combinations thereof.

The present combination or antagonist can also be administered parenterally, for example, intravenously, intra-arterially, intraperitoneally, intrathecally, intraventricularly, intraurethrally, intrasternally, intracranially,  
15 intramuscularly or subcutaneously, or they may be administered by infusion or needleless injection techniques. For such parenteral administration they are best used in the form of a sterile aqueous solution which may contain other substances, for example, enough salts or glucose to make the solution isotonic with blood. The aqueous solutions should be suitably buffered (preferably to a  
20 pH of from 3 to 9), if necessary. The preparation of suitable parenteral formulations under sterile conditions is readily accomplished by standard pharmaceutical techniques well-known to those skilled in the art.

For oral and parenteral administration to human patients, the daily dosage level of each active element of the present combination or of the  
25 present antagonist will usually be from 0.01 to 50mg/kg body weight of the subject to be treated, preferably from 0.1 to 20mg/kg (in single or divided doses), or they may be administered by intravenous infusion at a dose of from 0.001 to 10mg/kg/hour.

For oral, parenteral, buccal or sublingual administration to a subject to be  
30 treated, the daily dosage level of each active element of the combination or of the antagonist may typically be from 10 to 500mg (in single or divided doses).

Thus tablets or capsules of the present combination or antagonist may contain from 5 to 100mg of each active element of the combination or of the antagonist for administration singly or two or more at a time, as appropriate. The physician in any event will determine the actual dosage which will be most suitable for  
5 any individual patient and it will vary with the age, weight and response of the particular patient. The above dosages are exemplary of the average case. There can, of course, be individual instances where higher or lower dosage ranges are merited and such are within the scope of this invention.

The present combination or antagonist can also be administered  
10 intranasally or by inhalation and are conveniently delivered in the form of a dry powder inhaler or an aerosol spray presentation from a pressurised container, pump, spray, atomiser or nebuliser, with or without the use of a suitable propellant, e.g. dichlorodifluoromethane, trichlorofluoromethane, dichlorotetrafluoroethane, a hydrofluoroalkane such as 1,1,1,2-  
15 tetrafluoroethane (HFA 134A [trade mark]) or 1,1,1,2,3,3,3-heptafluoropropane (HFA 227EA [trade mark]), carbon dioxide or other suitable gas. In the case of a pressurised aerosol, the dosage unit may be determined by providing a valve to deliver a metered amount. The pressurised container, pump, spray, atomiser or nebuliser may contain a solution or suspension of the active compound(s),  
20 e.g. using a mixture of ethanol and the propellant as the solvent, which may additionally contain a lubricant, e.g. sorbitan trioleate. Capsules and cartridges (made, for example, from gelatin) for use in an inhaler or insufflator may be formulated to contain a powder mix of the present combination or antagonist and a suitable powder base such as lactose or starch.

25 Aerosol or dry powder formulations are preferably arranged so that each metered dose or "puff" contains from 10 $\mu$ g to 1mg of each active element of the present combination or antagonist for delivery to the patient. The overall daily dose with an aerosol will be in the range of from 10 $\mu$ g to 10mg of each active element of the present combination or antagonist which may be administered in  
30 a single dose or, more usually, in divided doses throughout the day.

Alternatively, the present combination or antagonist can be administered in the form of a suppository or pessary, or they may be applied topically in the form of a gel, hydrogel, lotion, solution, cream, ointment or dusting powder.

The present combination or antagonist may also be dermally or transdermally administered, for example, by the use of a skin patch. They may also be administered by the pulmonary or rectal routes.

They may also be administered by the ocular route, particularly for treating allergic conditions of the eye. For ophthalmic use, the compounds can be formulated as micronised suspensions in isotonic, pH adjusted, sterile saline, or, preferably, as solutions in isotonic, pH adjusted, sterile saline, optionally in combination with a preservative such as a benzylalkonium chloride. Alternatively, they may be formulated in an ointment such as petrolatum.

For application topically to the skin, the present combination or antagonist can be formulated as a suitable ointment containing the active compound(s) suspended or dissolved in, for example, a mixture with one or more of the following: mineral oil, liquid petrolatum, white petrolatum, propylene glycol, polyoxyethylene polyoxypropylene compound, emulsifying wax and water. Alternatively, they can be formulated as a suitable lotion or cream, suspended or dissolved in, for example, a mixture of one or more of the following: mineral oil, sorbitan monostearate, a polyethylene glycol, liquid paraffin, polysorbate 60, cetyl esters wax, cetearyl alcohol, 2-octyldodecanol, benzyl alcohol and water.

Each element of the present combination or the present antagonist may also be used in combination with a cyclodextrin. Cyclodextrins are known to form inclusion and non-inclusion complexes with drug molecules. Formation of a drug-cyclodextrin complex may modify the solubility, dissolution rate, bioavailability and/or stability property of a drug molecule. Drug-cyclodextrin complexes are generally useful for most dosage forms and administration routes. As an alternative to direct complexation with the drug the cyclodextrin may be used as an auxiliary additive, e.g. as a carrier, diluent or solubiliser.

Alpha-, beta- and gamma-cyclodextrins are most commonly used and suitable examples are described in WO-A-91/11172, WO-A-94/02518 and WO-A-98/55148.

5       The present invention embraces any other suitable formulations and administration routes described in EP 1096009 A1 (European Patent Application no. 00309364.8).

      The present combination or antagonist can also be administered together with a steroid, a beta-adrenoceptor agonist, a muscarinic antagonist or a mucolytic.

10       The present combination, antagonist or composition can be used to treat the above-mentioned conditions in humans or in other animals.

      It is to be appreciated that all references herein to treatment include curative, palliative and prophylactic treatment.

### PHARMACOLOGICAL DATA

#### a) Selectivity of antagonists for the histamine H<sub>3</sub> and H<sub>4</sub> receptors

- 5 WO98/06394 discloses histamine H<sub>3</sub> receptor antagonists including thioperamide and clobenpropit without mention of any antagonist activity for the histamine H<sub>4</sub> receptor.

Thioperamide, clobenpropit and iodophenpropit were tested for (i) binding affinity for the histamine H<sub>4</sub> receptor using the method described on page 7  
10 using the HEK293 cell line, and (ii) binding affinity for the histamine H<sub>3</sub> receptor using the method described on page 7 using human brain tissue which naturally expresses the histamine H<sub>3</sub> receptor. The results are shown below.

Compound	H <sub>4</sub> binding affinity (pKi)	H <sub>3</sub> binding affinity (pKi)
15 Thioperamide	7.26 +/- 0.06	6.79 +/- 0.10
Clobenpropit	8.18 +/- 0.02	8.63 +/- 0.04
20 Iodophenpropit	7.87 +/- 0.04	7.94 +/- 0.10

(A difference of 1.0 log. unit would indicate a 10-fold selectivity for the receptor for which the highest pKi value was obtained)

25

These data clearly show that thioperamide, clobenpropit and iodophenpropit are both histamine H<sub>3</sub> and H<sub>4</sub> receptor antagonists but have little selectivity for the histamine H<sub>4</sub> receptor over the histamine H<sub>3</sub> receptor. They are certainly not 10-fold selective.

b) Histamine-induced chemotaxis of human eosinophils

- Using the interleukin 5 priming method of page 8 it was demonstrated that histamine promoted chemotaxis of human isolated eosinophils over a concentration range of  $10^{-8}$  to  $10^{-5}$  M. However, agonists individually selective for the  $H_1$  (HTMT),  $H_2$  (dimaprit) and  $H_3$  (imetit) receptors each did not promote chemotaxis of human eosinophils at concentrations of from  $10^{-8}$  to  $10^{-5}$  M.
- 10 Using the eosinophil pre-incubation method of page 8 it was demonstrated that the non-selective  $H_4/H_3$  antagonists thioperamide maleate and clobenpropit dihydrobromide inhibited histamine-induced chemotaxis of human eosinophils in a concentration related manner with  $IC_{50}$ s of 0.83 and 1.50 micromolar, respectively. In contrast antagonists individually selective for the  $H_1$  receptor
- 15 (mepyramine maleate) and the  $H_2$  receptor (cimetidine) had little or no effect on histamine-induced chemotaxis at concentrations of 10 micromolar.

- These data show that histamine-induced chemotaxis of human eosinophils
- 20 must be mediated by activation of the histamine  $H_4$  receptor. As such histamine  $H_4$  receptor antagonists may be advantageously used in treating asthma and allergic rhinitis since (i) they are likely to inhibit eosinophil infiltration into the nose and thus relieve nasal congestion by an additional or independent mechanism to antagonism of the histamine  $H_3$  receptor, or (ii) by
- 25 inhibiting eosinophil infiltration into the lung they are likely to reduce the inflammation associated with asthma and provide an effective alternative treatment for this disease. A combination of a selective histamine  $H_4$  receptor antagonist and a histamine  $H_1$  receptor antagonist may therefore be advantageously used to treat allergic rhinitis since it would treat all the main
- 30 symptoms of this disease including nasal congestion. A combination of a selective histamine  $H_4$  receptor antagonist and a histamine  $H_1$  receptor



antagonist may also be advantageously used to treat asthma since it may improve lung function in a synergistic manner.

CLAIMS

1. A combination of (a) a histamine H<sub>1</sub> receptor antagonist and (b) an antagonist that is at least 10-fold selective for the histamine H<sub>4</sub> receptor as compared to the histamine H<sub>3</sub> receptor.  
5
2. A combination of (a) a histamine H<sub>1</sub> receptor antagonist and (b) an antagonist that is at least 10-fold selective for the histamine H<sub>4</sub> receptor as compared to the histamine H<sub>3</sub> receptor, for use as a medicament.  
10
3. A combination of (a) a histamine H<sub>1</sub> receptor antagonist and (b) an antagonist that is at least 10-fold selective for the histamine H<sub>4</sub> receptor as compared to the histamine H<sub>3</sub> receptor, for administration simultaneously, separately or sequentially, for use as a medicament for the treatment of a disease or disorder that may be treated by antagonism of either or both of the histamine H<sub>1</sub> and H<sub>4</sub> receptors such as allergic rhinitis or asthma.  
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4. The use of a combination of (a) a histamine H<sub>1</sub> receptor antagonist and (b) an antagonist that is at least 10-fold selective for the histamine H<sub>4</sub> receptor as compared to the histamine H<sub>3</sub> receptor, for administration simultaneously, separately or sequentially, for the manufacture of a medicament for the treatment of a disease or disorder that may be treated by antagonism of either or both of the histamine H<sub>1</sub> and H<sub>4</sub> receptors such as allergic rhinitis or asthma.  
20
5. A method of treatment of a mammal, including a human being, to treat a disease or disorder that may be treated by antagonism of either or both of the histamine H<sub>1</sub> and H<sub>4</sub> receptors such as allergic rhinitis or asthma including simultaneous, separate or sequential administration to the mammal of a (a) an effective amount of a histamine H<sub>1</sub> receptor antagonist  
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and (b) an effective amount of an antagonist that is at least 10-fold selective for the histamine H<sub>4</sub> receptor as compared to the histamine H<sub>3</sub> receptor.

6. A pharmaceutical composition including (a) a histamine H<sub>1</sub> receptor antagonist and (b) an antagonist that is at least 10-fold selective for the histamine H<sub>4</sub> receptor as compared to the histamine H<sub>3</sub> receptor, and a pharmaceutically acceptable excipient, diluent or carrier.
7. A product containing (a) a histamine H<sub>1</sub> receptor antagonist and (b) an antagonist that is at least 10-fold selective for the histamine H<sub>4</sub> receptor as compared to the histamine H<sub>3</sub> receptor as a combined preparation for simultaneous, separate or sequential use in the treatment of a disease or disorder that may be treated by antagonism of either or both of the histamine H<sub>1</sub> and H<sub>4</sub> receptors such as allergic rhinitis or asthma.
8. An antagonist that is at least 10-fold selective for the histamine H<sub>4</sub> receptor as compared to the histamine H<sub>3</sub> receptor.
9. A pharmaceutical composition including an antagonist as claimed in claim 8 and a pharmaceutically acceptable excipient, diluent or carrier.
10. An antagonist as claimed in claim 8 or composition as claimed in claim 9 for use as a medicament.
11. An antagonist as claimed in claim 8 or composition as claimed in claim 9 for use as a medicament for the treatment of a disease or disorder that may be treated by antagonism of the histamine H<sub>4</sub> receptor such as allergic rhinitis or asthma.
12. The use of an antagonist as claimed in claim 8 or a composition as claimed in claim 9 for the manufacture of a medicament for the treatment of a

disease or disorder that may be treated by antagonism of the histamine H<sub>4</sub> receptor such as allergic rhinitis or asthma.

13. A method of treatment of a mammal, including a human being, to treat a  
5 disease or disorder that may be treated by antagonism of the histamine H<sub>4</sub> receptor such as allergic rhinitis or asthma which includes administration to the mammal of an effective amount of an antagonist as claimed in claim 8 or a composition as claimed in claim 9.

# PATENT COOPERATION TREATY

## PCT

### DECLARATION OF NON-ESTABLISHMENT OF INTERNATIONAL SEARCH REPORT

(PCT Article 17(2)(a), Rules 13ter.1(c) and Rule 39)


Applicant's or agent's file reference <b>PCS10963AKSR</b>	IMPORTANT DECLARATION	Date of mailing(day/month/year) <b>13/05/2002</b>
International application No. <b>PCT/IB 02/ 00042</b>	International filing date(day/month/year) <b>10/01/2002</b>	(Earliest) Priority date(day/month/year) <b>17/01/2001</b>
International Patent Classification (IPC) or both national classification and IPC		A61P11/00,06 A61K45/06
Applicant <b>PFIZER LIMITED</b>		

This International Searching Authority hereby declares, according to Article 17(2)(a), that **no international search report will be established** on the international application for the reasons indicated below

1. ☐ The subject matter of the international application relates to:
  - a. ☐ scientific theories.
  - b. ☐ mathematical theories
  - c. ☐ plant varieties.
  - d. ☐ animal varieties.
  - e. ☐ essentially biological processes for the production of plants and animals, other than microbiological processes and the products of such processes.
  - f. ☐ schemes, rules or methods of doing business.
  - g. ☐ schemes, rules or methods of performing purely mental acts.
  - h. ☐ schemes, rules or methods of playing games.
  - i. ☐ methods for treatment of the human body by surgery or therapy.
  - j. ☐ methods for treatment of the animal body by surgery or therapy.
  - k. ☐ diagnostic methods practised on the human or animal body.
  - l. ☐ mere presentations of information.
  - m. ☐ computer programs for which this International Searching Authority is not equipped to search prior art.
2. ☒ The failure of the following parts of the international application to comply with prescribed requirements prevents a meaningful search from being carried out:
 

☐ the description
☒ the claims
☐ the drawings
3. ☐ The failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions prevents a meaningful search from being carried out:
 

☐ the written form has not been furnished or does not comply with the standard.  
☐ the computer readable form has not been furnished or does not comply with the standard.
4. Further comments: See annex

Name and mailing address of the International Searching Authority  European Patent Office, P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Authorized officer  <b>Sylvia Hermier</b>
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## FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 203

All present claims relate to an extremely large number of possible compounds by their definition as "antagonist that is at least 10-fold selective for the histamine H4 receptor as compared to the histamine H3 receptor" and "histamine H1 receptor antagonist".

No compounds that fulfil the above requirements are disclosed in the application by means of structural features. Neither is there any indication as to identification of compounds that could be likely candidates. Although some H3/H4 receptor antagonists are tested (page 14 of the description), they do not fulfil the requirements of the claims, thus not providing any support for the claimed H3 and/or H4 receptor antagonists in their presently claimed activity.

Thus the claims encompass a genus of compounds defined only by their function, whereas the relationship between the structural features of the members of the genus and said function have not been defined in the application.

Neither is this relationship recognizable based upon information readily available to one skilled in the art. Thus a skilled person would not know how to make and use the claimed compounds.

Although (partially described) test procedures for assaying compounds are disclosed in the application (pages 7-8 of the description), there is no way of knowing beforehand whether any given compound could fall within the scope of what is claimed. It would require undue experimentation (i.e. be an undue burden) to randomly screen undefined compounds for their claimed activity.

Furthermore, the application does not demonstrate that the problem posed therein has been solved by any compound, alone or in combination. In other words, no compounds are defined that are effective, alone or in combination, as a medicament in the treatment of e.g. allergic rhinitis or asthma. The application therefore does not enable a skilled person to carry out the invention (Art. 5 PCT).

Furthermore, due to the above, a lack of clarity (and/or conciseness) arises to such an extent as to render a meaningful search of the claims impossible (Art. 6 PCT).

No search report can therefore be established for the present application.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.5), should the problems which led to the Article 17(2) declaration be overcome.

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